

Appendix H

Description of EPA Hydraulic Fracturing Study Publications Cited in This Assessment

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Table H-1. Titles, descriptions, and citations for EPA hydraulic fracturing study publications cited in this assessment.

Research project	Description	Citations
<i>Analysis of existing data</i>		
Literature Review	Review and assessment of existing papers and reports, focusing on peer-reviewed literature	Literature review is incorporated into this document.
Spills Database Analysis	Characterization of hydraulic fracturing-related spills using information obtained from selected state and industry data sources	U.S. EPA (U.S. Environmental Protection Agency). (2015). Review of state and industry spill data: characterization of hydraulic fracturing-related spills [EPA Report]. (EPA/601/R-14/001). Washington, D.C.: Office of Research and Development, U.S. Environmental Protection Agency.
Service Company Analysis	Analysis of information provided by nine hydraulic fracturing service companies in response to a September 2010 information request on hydraulic fracturing operations	Analysis of data received is incorporated into this document. ¹
Well File Review	Analysis of information provided by nine oil and gas operators in response to an August 2011 information request for 350 well files	U.S. EPA (U.S. Environmental Protection Agency). (2015). Review of well operator files for hydraulically fractured oil and gas production wells: Well design and construction [EPA Report]. (EPA/601/R-14/002). Washington, D.C.: Office of Research and Development, U.S. Environmental Protection Agency. Analysis of data received is also incorporated into this document. ²

¹ Data received and incorporated into this document is cited as: U.S. EPA (U.S. Environmental Protection Agency). (2013). Data received from oil and gas exploration and production companies, including hydraulic fracturing service companies 2011 to 2013. Non-confidential business information source documents are located in Federal Docket ID: EPA-HQ-ORD2010-0674. Available at <http://www.regulations.gov>

² Data received and incorporated into this document is cited as: U.S. EPA (U.S. Environmental Protection Agency). (2011). Sampling data for flowback and produced water provided to EPA by nine oil and gas well operators (non-confidential business information). US Environmental Protection Agency.
<http://www.regulations.gov/#!docketDetail:rpp=100:so=DESC:sb=docId:po=0:D=EPA-HQ-ORD-2010-0674>

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FracFocus Analysis	Analysis of data compiled from FracFocus 1.0, the national hydraulic fracturing chemical registry operated by the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission	<p>U.S. EPA (U.S. Environmental Protection Agency). (2015). Analysis of hydraulic fracturing fluid data from the FracFocus chemical disclosure registry 1.0 [EPA Report]. (EPA/601/R-14/003). Washington, D.C.: Office of Research and Development, U.S. Environmental Protection Agency. http://www2.epa.gov/hfstudy/analysis-hydraulic-fracturing-fluid-data-fracfocus-chemical-disclosure-registry-1-pdf</p> <p>U.S. EPA (U.S. Environmental Protection Agency). (2015). Analysis of hydraulic fracturing fluid data from the FracFocus chemical disclosure registry 1.0: project database. Washington, D.C.: U.S. Environmental Protection Agency, Office of Research and Development.</p> <p>U.S. EPA (U.S. Environmental Protection Agency). (2015). Analysis of hydraulic fracturing fluid data from the FracFocus chemical disclosure registry 1.0: Data management and quality assessment report [EPA Report]. (EPA/601/R-14/006). Washington, D.C.: U.S. Environmental Protection Agency, Office of Research and Development. http://www2.epa.gov/sites/production/files/2015-03/documents/fracfocus_data_management_report_final_032015_508.pdf</p>

Research project	Description	Citations
Scenario evaluations		
Subsurface Migration Modeling	Numerical modeling of subsurface fluid migration scenarios that explore the potential for fluids, including liquids and gases to move from the fractured zone to drinking water aquifers	<p>Kim, J; Moridis, GJ. (2013). Development of the T+M coupled flow–geomechanical simulator to describe fracture propagation and coupled flow–thermal–geomechanical processes in tight/shale gas systems. Computers and Geosciences 60: 184-198. http://dx.doi.org/10.1016/j.cageo.2013.04.023</p> <p>Kim, J; Moridis, GJ. (In Press). Numerical analysis of fracture propagation during hydraulic fracturing operations in shale gas systems. International Journal of Rock Mechanics and Mining Sciences.</p> <p>Kim, J; Um, ES; Moridis, GJ. (2014). Fracture Propagation, Fluid Flow, and Geomechanics of Water-Based Hydraulic Fracturing in Shale Gas Systems and Electromagnetic Geophysical Monitoring of Fluid Migration. SPE Hydraulic Fracturing Technology Conference, The Woodlands, Texas, USA. http://dx.doi.org/10.2118/168578-MS</p> <p>Reagan, MT; Moridis, GJ; Johnson, JN; Keen, ND. (2015). Numerical simulation of the environmental impact of hydraulic fracturing of tight/shale gas reservoirs on near-surface groundwater: background, base cases, shallow reservoirs, short-term gas and water transport. Water Resour Res 51: 1-31. http://dx.doi.org/10.1002/2014WR016086</p> <p>Rutqvist, J; Rinaldi, AP; Cappa, F; Moridis, GJ. (2013). Modeling of fault reactivation and induced seismicity during hydraulic fracturing of shale-gas reservoirs. Journal of Petroleum Science and Engineering 107: 31-44. http://dx.doi.org/10.1016/j.petrol.2013.04.023</p> <p>Rutqvist, J; Rinaldi, AP; Cappa, F; Moridis, GJ. (2015). Modeling of fault activation and seismicity by injection directly into a fault zone associated with hydraulic fracturing of shale-gas reservoirs. Journal of Petroleum Science and Engineering 127: 377-386. http://dx.doi.org/10.1016/j.petrol.2015.01.019</p>
Surface Water Modeling	Modeling of concentrations of selected chemicals at public water supplies downstream from wastewater treatment facilities that discharge treated hydraulic fracturing wastewater to surface waters	Weaver, JW; Xu, J; Mravik, SC. (In Press) Scenario analysis of the impact on drinking water intakes from bromide in the discharge of treated oil and gas waste water. J Environ Eng.

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Water Availability Modeling	Assessment and modeling of current and future scenarios exploring the impact of water usage for hydraulic fracturing on drinking water availability in the Upper Colorado River Basin and the Susquehanna River Basin	U.S. EPA (U.S. Environmental Protection Agency). (2015). Case study analysis of the impacts of water acquisition for hydraulic fracturing on local water availability [EPA Report]. (EPA/600/R-14/179). Washington, D.C.
Laboratory studies		
Source Apportionment Studies	Identification and quantification of the source(s) of high bromide and chloride concentrations at public water supply intakes downstream from wastewater treatment plants discharging treated hydraulic fracturing wastewater to surface waters	U.S. EPA (U.S. Environmental Protection Agency). (2015). Sources contributing bromide and inorganic species to drinking water intakes on the Allegheny river in western Pennsylvania [EPA Report]. (EPA/600/R-14/430). Washington, D.C.
Analytical Method Development	Development of analytical methods for selected chemicals found in hydraulic fracturing fluids or wastewater	DeArmond, PD; DiGoregorio, AL. (2013). Characterization of liquid chromatography-tandem mass spectrometry method for the determination of acrylamide in complex environmental samples. Anal Bioanal Chem 405: 4159-4166. http://dx.doi.org/10.1007/s00216-013-6822-4 DeArmond, PD; DiGoregorio, AL. (2013). Rapid liquid chromatography-tandem mass spectrometry-based method for the analysis of alcohol ethoxylates and alkylphenol ethoxylates in environmental samples. J Chromatogr A 1305: 154-163. http://dx.doi.org/10.1016/j.chroma.2013.07.017

Research project	Description	Citations
Analytical Method Development (cont.)	Development of analytical methods for selected chemicals found in hydraulic fracturing fluids or wastewater (cont.)	<p>U.S. EPA (U.S. Environmental Protection Agency). (2014). Development of rapid radiochemical method for gross alpha and gross beta activity concentration in flowback and produced waters from hydraulic fracturing operations [EPA Report]. (EPA/600/R-14/107). Washington, D.C. http://www2.epa.gov/hfstudy/development-rapid-radiochemical-method-gross-alpha-and-gross-beta-activity-concentration</p> <p>U.S. EPA (U.S. Environmental Protection Agency). (2014). The verification of a method for detecting and quantifying diethylene glycol, triethylene glycol, tetraethylene glycol, 2-butoxyethanol and 2-methoxyethanol in ground and surface waters [EPA Report]. (EPA/600/R-14/008). Washington, D.C. http://www2.epa.gov/hfstudy/verification-method-detecting-and-quantifying-diethylene-glycol-triethylene-glycol</p>
Retrospective case studies <i>Investigations of whether reported drinking water impacts may be associated with or caused by hydraulic fracturing activities</i>		
Las Animas and Huerfano Counties, Colorado	Investigation of potential drinking water impacts from coalbed methane extraction in the Raton Basin	U.S. EPA (U.S. Environmental Protection Agency). (2015). Retrospective case study in the Raton Basin, Colorado: study of the potential impacts of hydraulic fracturing on drinking water resources [EPA Report]. (EPA 600/R-14/091). Washington, D.C.
Dunn County, North Dakota	Investigation of potential drinking water impacts from a well blowout during hydraulic fracturing for oil in the Bakken Shale	U.S. EPA (U.S. Environmental Protection Agency). (2015). Retrospective case study in Killdeer, North Dakota: study of the potential impacts of hydraulic fracturing on drinking water resources [EPA Report]. (EPA 600/R-14/103). Washington, D.C.
Bradford County, Pennsylvania	Investigation of potential drinking water impacts from shale gas development in the Marcellus Shale	U.S. EPA (U.S. Environmental Protection Agency). (2014). Retrospective case study in northeastern Pennsylvania: study of the potential impacts of hydraulic fracturing on drinking water resources [EPA Report]. (EPA 600/R-14/088). Washington, D.C.
Washington County, Pennsylvania	Investigation of potential drinking water impacts from shale gas development in the Marcellus Shale	U.S. EPA (U.S. Environmental Protection Agency). (2015). Retrospective case study in southwestern Pennsylvania: study of the potential impacts of hydraulic fracturing on drinking water resources [EPA Report]. (EPA 600/R-14/084). Washington, D.C.

Research project	Description	Citations
Wise County, Texas	Investigation of potential drinking water impacts from shale gas development in the Barnett Shale	U.S. EPA (U.S. Environmental Protection Agency). (2015). Retrospective case study in Wise County, Texas: study of the potential impacts of hydraulic fracturing on drinking water resources [EPA Report]. (EPA 600/R-14/090). Washington, D.C.